A STUDY OF RIPARIAN BIRD COMMUNITIES FROM THE DRY INTERIOR OF BRITISH COLUMBIA

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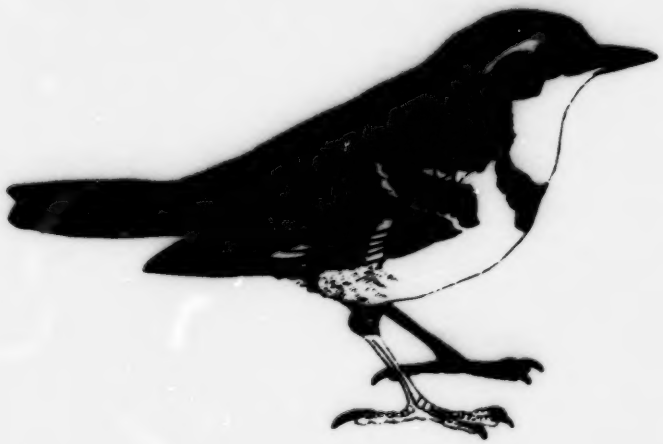

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A STUDY OF RIPARIAN BIRD COMMUNITIES FROM THE DRY INTERIOR OF BRITISH COLUMBIA

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ABSTRACT

The avifauna of riparian habitats were studied from four sites within two biogeoclimatic subzones. A total of 49 bird species were identified, with a maximum of 29 species at a given site. Riparian habitats in the Dry Submontane Interior Douglas-fir subzone supported a richer avifauna than those in the Dry Western Montane Interior Douglas-fir subzone. Bird species richness and nesting guild diversity both increased with the number of tree species and the length of the study site. Foraging and nesting guild proportions were not significantly different between sites. Biogeoclimatic subzones and guild characteristics appeared to be poor tools for managing riparian bird communities. The potential effects of the removal of snags and deciduous trees and shrubs from riparian communities are discussed.

RÉSUMÉ

On a étudié l'avifaune des habitats ripicoles à quatre endroits différents situés dans deux sous-zones biogéoclimatiques. On a identifié un total de 49 espèces d'oiseaux, dont 29 à un endroit donné. L'étude a révélé que les habitats ripicoles de la sous-zone sèche et pré montagnarde du sapin Douglas de l'intérieur avaient une avifaune plus abondante que la sous-zone sèche et montagnarde du sapin Douglas l'intérieur ouest. On a constaté que l'abondance et la diversité des espèces relevées dans le groupement des oiseaux lors de la nidification augmentaient toutes deux en fonction du nombre des espèces d'arbres et de la durée de l'observation. On n'a pas noté de différence notable entre les endroits étudiés en ce qui concerne le regroupement des oiseaux dans leur quête de nourriture lors de leur nidification. Les sous-zones biogéoclimatiques et les caractéristiques du phénomène du regroupement se sont révélées être de piètres outils dans la gestion des communautés d'oiseaux ripicoles. L'étude traite des effets pouvant résulter de l'enlèvement des souches, des arbres à feuilles caduques et des arbustes pour les communautés ripicoles.

INTRODUCTION

Riparian zones are characterized by narrow bands of deciduous shrubs and trees growing along the margins of water bodies. The close proximity to water maintains a high soil moisture level which promotes a dense, multispecies steplike vegetation profile.

According to Thomas et al. (1979), riparian zones are used by wildlife disproportionately more than any other North American habitat. Riparian habitats often create unique reservoirs of plant and animal diversity, especially in arid and semi arid environments. Many authors have found that both bird species diversity and density are extremely high in these communities (Pase and Layser 1977, Thomas et al.1979, Rosenberg et al. 1982, Anderson et al. 1983). The diversity and density of birds are considered by many to be largely controlled by specific aspects of the vegetation. These usually are visually obvious features such as canopy cover, tree height and the number of layers of foliage (MacArthur and MacArthur 1961, James 1971, Karr and Roth 1971, Thomas et al. 1977, Schwab 1979, Collins et al. 1982).

Thomas et al. (1979) list the following reasons why riparian zones are important to wildlife:

1) the presence of water provides food

2) the increased plant biomass creates greater species and structural diversity

3) the shape of many riparian zones, particularly the linear nature of streams, maximizes the development of edge

4) many vegetation strata are exposed in a steplike fashion providing numerous nesting and feeding opportunities.

Johnson et al. (1977) consider riparian zones to be the most

productive of North American wildlife habitats. Unfortunately vegetatively mature riparian communities are extremely sensitive to any habitat modifications that alter their distinct microclimate (Thomas et al. 1979). Due to their value to wildlife and their sensitivity, riparian habitats should be carefully managed. However, the majority of riparian zones are so different from one another that generalized community and species/habitat relationships are extremely difficult to develop (Johnson et al. 1977, Thomas et al. 1979). Consequently, the management of riparian zones has been difficult.

In most regions of North America riparian habitats are rapidly disappearing due to urbanization, forestry operations, agriculture and grazing of domestic stock along with water management practices such as flood control and water salvage (Carothers and Johnson 1975, Runka and Lewis 1981). Riparian zones in British Columbia face the same threats especially in the dry interior. This area covers the valley bottoms and foothills from Lytton - Ashcroft south to Osoyoos, and the main Fraser River trench from Lytton to the confluence of the Fraser and Chilcotin rivers. Threatened riparian plant associations include (1) Populus balsamifera trichocarpa - Rosa nutkana, (2) Populus - Pinus ponderosa - Rosa and (3) Betula occidentalis - Salix rigida - Rosa (Pojar 1980).

Other than the study by Bull and Skovlin (1982) of riparian bird communities in northeastern Oregon, there appears to be a dearth of local information that is applicable to British Columbia.

The following report describes four riparian habitats from the dry interior of British Columbia and the bird species encountered in each. Two of the above threatened plant associations (1 and 3) occurred in

part, within one of the study sites (site 3).

STUDY AREA

Figure 1 shows the approximate location of the four study sites. Sites 1 and 2 were located within the Dry Western Montane Interior Douglas-fir Biogeoclimatic subzone (IDFd) whereas, sites 3 and 4 occurred in the Dry Submontane Interior Douglas-fir subzone (IDFc) (Mitchell and Green 1981).

Site 1 (elevation 975m) was situated along the Similkameen River approximately 31km south of Princeton. Site 2 (1000m) was also along the Similkameen approximately 18km northeast of Manning Park Lodge.

Site 3 (750m) was adjacent to the Coldwater River roughly 21km south, southwest of Merritt whereas, site 4 (750m) bordered Nidday Creek approximately 3km northeast of site 3.

METHODS

Sites that were easily accessible and represented typical riparian communities were selected for this study. To describe the vegetation at each site, a modification of the Releve' Analysis method was used (Walmsley et al. 1980). In brief, this technique involved walking through a site several times listing all shrub and tree species. Shrubs (and tree seedlings) were all woody stems between 1 and 4m whereas, trees were those stems greater than 4m in height. No attempt was made to identify ground vegetation (less than 1m) to species. Once all species were listed, percent cover values were assigned to each vegetation layer (ie tree, shrub and ground). Cover was defined as the proportion of the ground occupied by a vertical projection to the ground from the aerial parts of the plant (Brower and Zar 1977). At those sites where there were several horizontal bands of vegetation, the percentage values referred to

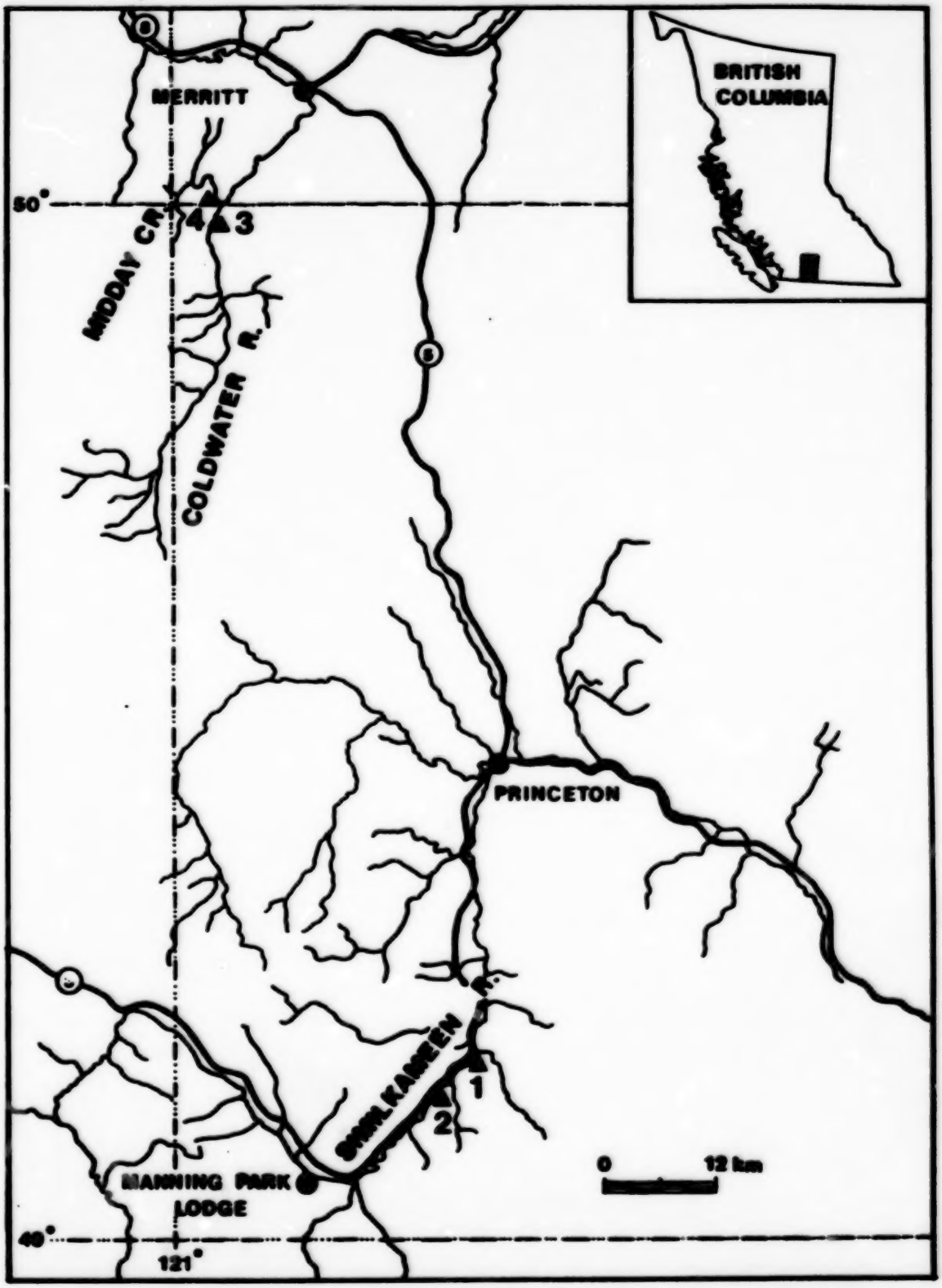

FIGURE 1. The approximate locations of the four study sites in southern British Columbia. All sites were located in the Interior Douglas-fir Biogeoclimatic zone.

the proportion of the surface area of that particular band. Due to the often patchy distribution of the vegetation, both the average and the range of cover is listed. For a detailed description of the Releve' method, see Mueller-Dombois and Ellenberg (1974).

In addition to determining average tree, shrub and ground covers, the heights of the tree and shrub strata were estimated and the presence or absence of snags was noted. Plant nomenclature used throughout this report followed that of Taylor and MacBryde (1977). Scientific names for both plants and birds are listed in Appendix 1.

Between mid-June and mid-July 1985, bird species were inventoried four times at each site. Each site was visited three times in the morning (between 8 and 10 AM) and once in the evening (between 7 and 9 PM). From two to four observers took part in each inventory.

Birds were identified both visually and by song. All species observed within a site were noted. In addition, if a species was seen flying above a site at least once on each visit, it also was tallied. To aid in identification, each observer used 8 power binoculars. No attempt was made to estimate the relative abundance of each bird species, nor the total density. Common and scientific names are after Campbell and Nagorsen (1985).

The degree of avian similarity between the four sites was tested by calculating the Sorensen coefficient (Sorensen 1948). The coefficients were calculated as follows: $Ss = (2C/A+B)*100$ where C is the number of species occurring in both sites and A and B are the total number of species in each site. As Ss values are expressed as percentages, they can range from 0 to 100. However, Beals (1960) and Wadsworth (1970) found that replicate samples for a single plot seldom produced coefficients

greater than 85%.

Species richness (the number of species), similarity index (the summation of all Sorensen coefficients for a given site), nesting diversity and foraging diversity were tested for correlation with several habitat variables. To do this, Pearson Product-moment Correlation Coefficients were calculated.

The diversity of nesting and foraging guilds were calculated for each site using the Shannon-Weaver Index (Shannon and Weaver 1949) as follows: $H' = -\Sigma(pi * Lnpi)$ where pi is the proportion of the total number of individuals occurring in guild i.

Species were categorized by nesting and foraging guilds (Table 1) according to the following sources: Meslow and Wight (1975), Bull (1978), Noon et al. (1979), Thomas et al.(1979), Sanderson et al. (1980), Verner and Boss (1980) and Emmett (1983). Guilds were considered to be groupings of often unrelated species exploiting a resource in a similar manner. It was not assumed that all bird species encountered were nesting within the riparian sites studied. Rather, many of the species may only have been exploiting the sites for foraging and/or concealment purposes. However, in order to compare the guild structures of all four sites, all species were treated as if they were nesting and foraging within the sites.

To test whether there were significantly different mixes of guilds between sites, the chi square test was employed.

HABITAT DESCRIPTIONS

Throughout this section of the manuscript, plant species have been listed in descending order of cover. Table 2 summarizes the average cover for each site.

SITE 1

TABLE 1. Nesting and foraging guild categories.

CODE	NESTING GUILD	CODE	FORAGING GUILD
1	on or underground, cliffs, banks	a	in water
2	low brush, saplings	b	on ground
3	mainly deciduous trees	c	foliage and bark
4	mainly coniferous trees	d	bark drilling
5	deciduous or coniferous trees	e	hovering/sallying
6	cavity (primary and secondary)	f	aerial pursuit
7	nest parasite	g	raptor
8	—	h	nectar/sap wells

Note: each species was given a double code
eg. Common Merganser (6/a): nests in cavity, forages in water

TABLE 2. Summary of percent ground, shrub and tree covers by site. Where there was a range of cover values in a band, the average cover for that band is listed.

	Site Number								
	1		2		3				4
Band	a	b	a	b	a	b	c	d	a
Vegetation Layer									
Ground	15	45	40	25	30	70	5	10	40
Shrub	10	25	10	55	5	10	70	35	45
Tree	25	20	35	40	30	0	0	30	65

Site 1 extended for 300m along the Similkameen River and covered approximately 0.42ha. Due to the high conifer content, this site did not completely conform to the true definition of a riparian habitat. However, this type of riverine plant community is quite common in southwestern British Columbia and was therefore included in this study.

There were two distinct horizontal bands of vegetation at site 1. Band a, composed of clumps of Western Red-osier Dogwood, Speckled Mountain Alder and Common Saskatoon, interspersed with saplings of White Spruce and Rocky Mountain Douglas-fir was adjacent to the river. This band was approximately 3 to 4m wide by 6 to 8m in height and created an average cover of 25%. Underneath this tree layer was a limited shrub layer made up of the above species. Shrub cover was approximately 10%. Beneath the shrub layer was a ground cover of approximately 15%.

Farther back from the water occurred band b, a 6 to 10m wide stand of Lodgepole Pine, Rocky Mountain Douglas-fir and White Spruce. Tree heights ranged between 18 and 24m forming an open canopy with 20% cover. Beneath this canopy was a discontinuous shrub layer that created approximately 25% cover. This layer was made up of immature Rocky Mountain Douglas-fir and Lodgepole Pine as well as lesser amounts of Common Saskatoon, Wood's Rose, Salix sp., Soopolallie and Common Snowberry. Ground vegetation beneath this layer averaged 45% cover. There were no snags observed in either of the two vegetation bands.

This type of riverine habitat continued both up and downstream from site 1. However, access upstream was blocked by a steep rock face whereas a campground downstream made further study in that direction impractical.

SITE 2

Extending for approximately 250m along the Similkameen River, site 2

covered roughly 0.94ha. This riparian habitat consisted of two bands of deciduous growth. Band a, a 2 to 3m wide continuous strip of Speckled Mountain Alder, Black Cottonwood, Geyer's Willow and Western Red-osier Dogwood grew next to the river. Trees averaged 6 to 8m in height and produced 35% cover. There were very few shrubs in this band, creating a cover of less than 10%. Ground vegetation was fairly continuous, averaging 40% cover.

Abutting band a, band b was a 30 to 40m wide Black Cottonwood forest averaging 18 to 22m in height. Canopy cover ranged between 30 and 50%. Beneath the upper canopy was a 10 to 12m subcanopy of Speckled Mountain Alder and subordinate Black Cottonwoods. This second layer created an additional 25% cover. White Spruce and Lodgepole Pine were also infrequent in the subcanopy. Beneath the tree layers was a patchy to dense shrub layer composed of Western Red-osier Dogwood, Salix sp., Twinberry Honeysuckle, Soopolallie and Rosa sp.. This layer was predominantly 1 to 2m tall and produced on average a cover of 55% (range 10 to 70%). Reflecting the patchiness of the upper vegetation layers, the ground cover varied between 5 and 40% (average 25%). Snags although scarce, were scattered throughout the site.

Site 2 was a fairly discrete block of riparian habitat, bordered on three sides by a forest of White Spruce, Rocky Mountain Douglas-fir and Lodgepole Pine.

SITE 3

Following the Coldwater River for nearly 400m, site 3 covered roughly 1.02ha. Partially dried river channels and abundant log debris indicated that during spring runoff, this site was subjected to flooding. Site 3 was a discrete patch of riparian habitat bounded by raised

riverbanks (that supported conifers) and a road cut.

Immediately adjacent to the river (and the recently exposed gravel bars) grew a discontinuous band of Western Red-osier Dogwood, Black Cottonwood, Thin-leaved Mountain Alder, Mackenzie Willow, Peachleaf Willow and Western Birch (band a). This strip of vegetation varied between 3 and 12m wide. Trees averaged 4 to 5m in height and produced approximately 30% cover. Beneath the tree canopy was a very limited shrub layer (5% cover) made up of the above species. Ground cover was more abundant, averaging 30% (range 25 to 40%).

Next to and occassionally jutting into band a was a series of small openings 3 to 4m wide (band b). These clearings, devoid of trees and shrubs were thickly covered (60 to 80%) by grasses, herbs and scattered clumps of low growing Bristly Nootka Rose and Twinberry Honeysuckle.

Behind these openings was a dense tangle of 2.5 to 3m tall Western Red-osier Dogwood and Black Cottonwood saplings forming 65 to 80% cover (band c). There were no trees in this band and ground cover was very impoverished (less than 5%).

Abutting this shrub layer and frequently overtopping it was band d, a patchy Black Cottonwood forest. This stand was estimated to be at least 150m deep. However, due to the dense almost impenetrable edge of this forest, only the first 15m were included in the study area. Trees averaged 28 to 32m in height. Canopy closure, which was extremely variable (20 to 70%), averaged 30%. A few Rocky Mountain Douglas-fir occurred in this otherwise pure Black Cottonwood forest. Snags were relatively common. Responding to the variation in the canopy the shrub layer (Western Red-osier Dogwood, Thin-leaved Mountain Alder and Salix sp.) ranged between 5 and 65% cover (average 35%). Ground vegetation was

limited to 10% cover.

SITE 4

Site 4 followed Midday Creek (a tributary of the Coldwater River) for close to 1000m and covered approximately 1.50ha. The site was bounded on one side by a pasture and by a dry rocky slope on the other (neither of which were sampled). This strip of riparian vegetation, which measured between 10 and 20m in width, extended in both directions from the study site.

Immediately next to Midday Creek and frequently overtopping it was a dense growth of Western Chokecherry, Common Saskatoon, Thin-leaved Mountain Alder, Western Red-osier Dogwood, Black Cottonwood, Trembling Aspen, Pacific Willow, Bebb's Willow and Coyote Willow. The height of this community ranged between 8 and 9m, although there were a few Trembling Aspen up to 16m tall. Canopy cover averaged 65% (range 55 to 80%).

Below the tree canopy was a relatively dense shrub layer 2 to 3m tall. This layer created roughly 45% cover (25 to 65%) and was made up of seedlings of the above trees as well as Nootka Rose and Twinberry Honeysuckle. Ground cover was fairly extensive, ranging between 30 and 55% (average 40%). Snags were quite common throughout site 4.

RESULTS and DISCUSSION

49 bird species were identified in this study, with a range of 15 to 29 species at any one site (Table 3). By comparison, Bull and Skovlin (1982) studying 6 streams, encountered 56 species with 11 to 22 species per site. The above authors counted only those species that were seen, ignoring those that were merely heard. This no doubt deflated species richness, whereas the inclusion of non-breeders in this study would tend

TABLE 3. Summary of species observed at each site. Nesting and foraging guild codes are in parentheses (see Table 1 for codes). Species that select riparian type habitats for nesting (after Niemi and Pfannmuller 1979 and Thomas 1979) are indicated by " r " after the codes.

SPECIES	SITE NUMBER 1	2	3	4
Common Merganser (6/a)r			•	
American Kestrel (6/g)			•	
Ruffed Grouse (1/b)		•		
Spotted Sandpiper (1/a)r	•	•	•	
Common Snipe (1/b)r				•
Vaux's Swift (6/f)	•		•	
Calliope Hummingbird (5/h)			•	
Rufous Hummingbird (5/h)r		•		•
Belted Kingfisher (1/a)r	•		•	
Yellow-bellied Sapsucker (6/d)r	•			•
Downy Woodpecker (6/d)r				•
Hairy Woodpecker (6/d)				•
Northern Flicker (6/b)				•
Pileated Woodpecker (6/d)			•	
Western Wood-Pewee (5/e)	•			
Alder Flycatcher (3/e)r				•
Hammond's Flycatcher (2/e)	•	•	•	
Western Flycatcher (4/e)	•		•	•
Northern Rough-winged Swallow (1/f)r	•		•	
Barn Swallow (1/f)	•			
American Crow (5/b)				•
Black-capped Chickadee (6/c)r		•	•	•
Mountain Chickadee (6/c)		•		•
American Dipper (1/a)r	•		•	
Veery (1/b)r			•	•
Swainson's Thrush (2/b)	•	•	•	•
American Robin (2/b)		•	•	
Cedar Waxwing (3/c)r	•		•	
Solitary Vireo (5/c)				•
Warbling Vireo (3/c)r		•	•	•
Red-eyed Vireo (5/c)r			•	•
Nashville Warbler (1/c)			•	•
Yellow Warbler (2/c)r	•		•	•
Chestnut-sided Warbler (2/c)r			•	
Yellow-rumped Warbler (4/c)	•	•	•	
Townsend's Warbler (4/c)	•			
American Redstart (3/e)r			•	•
Northern Waterthrush (1/b)r			•	•
MacGillivray's Warbler (2/c)r	•	•	•	•
Wilson's Warbler (1/b)r		•	•	•
Western Tanager (4/c)	•			
Lazuli Bunting (3/c)r			•	•
Chipping Sparrow (2/b)	•		•	•
Song Sparrow (2/b)r		•		•
White-crowned Sparrow (2/b)		•		
Brown-headed Cowbird (7/b)				•
White-winged Crossbill (4/c)		•		
Pine Siskin (5/c)	•			•
American Goldfinch (2/c)r				•
TOTAL	19	15	28	29

FIGURE 2. Matrix of Sorensen Coefficients (Ss) for each site pair combination. Increasing percent values indicate higher similarity between pairs of sites. Similarity indices (and method of calculation) for each site are also presented.

Site Number	4	3	2
1	33.3	55.3	29.4
2	36.4	41.9	
3	52.6		

Note: Similarity index (Si) method of calculation (eg for site 1) Si(1) = Ss(1&2) + Ss(1&3) + Ss(1&4) = 118; Si(2) = 107.7; Si(3) = 149.8; Si(4) = 122.3

to inflate richness.

Less than half (45%) of the total number of bird species were encountered in both biogeoclimatic subzones. While there were 7 species unique to the IDFd sites, 20 species observed within the IDFc subzone were not seen in either IDFd site. This could be interpretted to indicate that riparian sites within a single biogeoclimatic subzone were more similar to each other than to riparian habitats in other subzones. However, Figure 2 which shows the degree of species similarity between all site pair combinations does not support this idea. The highest similarity occurred between sites 1 and 3 (55.3% in common), whereas sites 1 and 2 shared the fewest species (29.4%).

Bull and Skovlin (1982) observed that while there were considerable differences in bird species composition between similar riparian habitats, there were little differences in the total number of species.

In contrast to the above, we found that between sites there was not only a large variation in bird species composition, but also a considerable difference in the total number of species (Table 3). While the four study sites occurred within one biogeoclimatic zone, we suggest that in terms of avian habitat, the vegetation of each site was distinct.

Based on the above, we believe that management guidelines for riparian birds should be designed and applied only on a local level. Guidelines developed for biogeoclimatic zones (or subzones) will undoubtedly produce poor results. As stated earlier, Thomas et al. (1979) suggested that it was difficult to develop management policies that could be effectively applied to more than a single riparian community.

Table 4 shows the results of the correlation tests between bird and habitat variables. An increasing number of tree species showed the

TABLE 4. Pearson Product-moment Correlation Coefficients (r) between avian and habitat community variables.

	Length (m)	Width (m)	Area (ha)	Grcov (%)	Shrcov (%)	Trcov (%)	Trht (m)	# Trsp
Richness	.74	-.43	.65	.19	.33	.18	.06	.83
Similarity Index	.09	-.12	.18	.79	.77	-.25	.71	.25
Nesting Diversity	.95**	-.68	.65	-.87	-.25	-.16	-.48	.94*
Foraging Diversity	-.36	-.29	-.47	-.18	.49	-.69	.06	.21

Note:

Richness = number of bird species

Length = total site length

Width = average width of site

Area = length X width

Grcov = total ground cover (all bands, except band b site 3)

Shrcov = total shrub cover

Trcov = total tree cover

Trht = maximum tree height

Trsp = total number of tree species

** = $p < .05$ (rc=0.950),

* = $p < .10$ (rc=0.900)

strongest ($p<.17$, ns) relationship with increasing bird species richness. Holmes and Robinson (1981) found that while common bird species used trees roughly in proportion to their availability, the distribution and abundance of rarer bird species was linked to the presence and distribution of certain species of trees. This suggests that the relationship observed here between species richness and the number of tree species was not fortuitous.

Stauffer and Best (1980) found a highly significant relationship between the width of the riparian zone and the number of bird species. While we did not observe such a relationship, there was a weak correlation between bird species richness and site length ($p<.26$, ns). The possible relationship between bird species richness and the area of the study site ($p<.35$,ns) has been observed elsewhere. Beals (1960) and Galli et al. (1976) found an increase in species richness with increasing habitat patch size.

The results from our study suggest that the composition of the vegetation and the extent of the riparian zone both play important roles affecting the diversity of birds.

Table 4 also shows weak relationships between similarity indices and ground ($p<.21$) and shrub ($p<.23$) cover. While these relationships were not significant, they do suggest that sites with abundant ground and shrub cover support more bird species in common.

The strongest correlations existed between nesting diversity and the length of the site ($p<.05$) (also with the number of tree species ($p<.10$)). Again the results suggest that long stretches of riparian habitat (creating abundant edge), with a large variety of tree species, will promote the richest breeding population.

Tables 5 and 6 display the number of bird species at each site by nesting and foraging guilds respectvely. Nesting guild diversities were quite similar between the four study sites, although the IDFc subzone did appear to provide more diverse nesting opportunities. In contrast, each subzone was characterized by both high and low foraging diversities.

To test whether there were significant differences in the number of species (by guild) between all sites, the chi square test was applied. The results indicated that the differences in guild proportions between sites were not statistically significant. This suggested that either the guild proportions were relatively constant between sites, or that the inclusion o. all species (whether or not they were actually nesting or foraging) created an artifact.

There was no accurate way of separating those species not foraging within the study sites from those that were. However, to investigate the effect of including non-nesting species in the chi square calculations, the following method was applied. Lifeform tables (from Niemi and Pfannmuller (1979) and Thomas (1979)) were examined to determine the importance of riparian habitats to each species. If riparian zones were not among those habitats listed as being of primary importance to nesting, that species was eliminated from the list. This reduced the total species list to 24 (see Table 3). This subset was tested to determine if there were significant differences in guild proportions between sites. Again the chi square test results showed that the differences were not significant.

It is suggested that habitat changes most likely impact on members of the same guild in a fairly similar manner. A drawback to lumping unrelated species into guilds is the fact that while these birds may

TABLE 5. Number of bird species observed at each site categorized into nesting guilds. The nesting diversity of each site (Shannon-Weaver index) is also listed. The numbers in parentheses are a subset of species that are known to select riparian habitats for nesting (see Table 3).

	Site			
Nest Location	1	2	3	4
Ground etc.	5(4)	3(2)	8(7)	5(4)
Low brush	5(2)	6(2)	7(3)	6(4)
Deciduous trees	1(1)	1(1)	4(4)	5(5)
Coniferous trees	4(0)	2(0)	2(0)	1(0)
Any tree	2(0)	1(1)	2(1)	5(2)
Cavity	2(1)	2(1)	5(2)	6(3)
Nest parasite	0(0)	0(0)	0(0)	1(0)
Guild Diversity	1.66	1.59	1.67	1.79

Note: to test for significant differences in guild proportions between sites, the nest parasite guild was lumped with low brush nesters.

chi square = 10.34 (chi square 5% significance level, 15 degrees of freedom = 24.99): not significant

when numbers in parentheses were tested chi square = 4.25 (5% level, 12 degrees of freedom = 21.03): not significant

TABLE 6. Number of bird species observed at each site categorized into foraging guilds. The foraging diversity (Shannon-Weaver index) is also listed.

	Site			
Foraging Location	1	2	3	4
Water	3	1	4	0
Ground	2	6	6	10
Foliage/bark	7	6	10	12
Bark (drill)	1	0	1	3
Hover/sally	3	1	3	3
Aerial pursuit	3	0	2	0
Raptor	0	0	1	0
Nectar/sap wells	0	1	1	1
Guild Diversity	1.63	1.28	1.76	1.32

Note: to test for significant differences in guild proportions between sites, the raptor guild was lumped with the aerial pursuit guild.

chi square = 18.79 (chi square 5% significance level, 18 degrees of freedom = 28.87): not significant

place their nests in the same general locations, differences in preferred habitats are ignored (Bull and Skovlin 1982). If riparian management guidelines were formulated solely on the basis of guild characteristics, it is likely that numerous species of birds and unique microhabitats would be adversely affected.

Bull and Skovlin (1982) stated that the richness of riparian bird species was controlled primarily by the presence of deciduous trees and shrubs. They considered what impact the removal of deciduous vegetation would have on riparian birds and predicted that 8 of 56 species using riparian zones in northeastern Oregon would be dramatically affected. In Iowa, Stauffer and Best (1980) predicted that 11 of 41 riparian species would decrease if deciduous shrubs and trees were removed and an additional 9 species would suffer if snags were eliminated.

From the results of this study, as many as 25 of 49 species (guilds 2,3 and 6) would likely be seriously affected by land use activities such as forestry, agriculture or livestock grazing that reduced or eliminated deciduous trees and shrubs and snags from riparian habitats.

CONCLUSIONS

Due to the differences between riparian zones, it is suggested that management goals should be towards maximizing bird species diversity by maintaining large units with a great variety of plant species and towards maintaining the complete range of riparian habitats that exist in a particular area. From the results of this study it is apparent that policies should be formulated on the basis of local species/habitat relationships. We feel that this study clearly demonstrates that biogeoclimatic zones are not suitable boundaries for determining habitat management policies. Similarly, a method that uses guilds to manage

riparian zones will most likely be as unsatisfactory.

The richness of birds encountered in this study indicates how valuable riparian zones are. The importance of these habitats to birds is felt to be primarily a result of the abundance and variety of trees and shrubs (notably deciduous species) especially in arid and semi arid environments.

Private landowners should be encouraged to protect riparian communities and management goals must be formulated in order to preserve these valuable reservoirs of animal and plant diversity.

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APPENDIX 1. Common and scientific names of plants and birds mentioned in text.

PLANTS

Lodgepole Pine	Pinus contorta var. latifolia
Rocky Mountain Douglas-fir	Pseudotsuga menziesii var. glauca
White Spruce	Picea glauca
Black Cottonwood	Populus balsamifera subsp. trichocarpa
Trembling Aspen	Populus tremuloides var. tremuloides
Bebb's Willow	Salix bebbiana
Coyote Willow	Salix exigua
Geyer's Willow	Salix geyeriana subsp. meleiana
Mackenzie Willow	Salix rigida var. mackenzieana
Pacific Willow	Salix lasiandra var. lasiandra
Peachleaf Willow	Salix amygdaloides
Speckled Mountain Alder	Alnus incana subsp. rugosa
Thin-leaved Mountain Alder	Alnus incana subsp. tenuifolia
Western Birch	Betula occidentalis var. occidentalis
Western Red-osier Dogwood	Cornus sericea
Common Saskatoon	Amelanchier alnifolia var. alnifolia
Western Chokecherry	Prunus virginiana subsp. demissa
Soopolallie	Shepherdia canadensis
Common Snowberry	Symphoricarpos albus var. albus
Bristly Nootka Rose	Rosa nutkana var. hispida
Wood's Rose	Rosa woodsii subsp. woodsii
Twinberry Honeysuckle	Lonicera involucrata

BIRDS

Common Merganser	Mergus merganser
American Kestrel	Falco sparverius
Ruffed Grouse	Bonasa umbellus
Spotted Sandpiper	Actitis macularia
Common Snipe	Gallinago gallinago
Vaux's Swift	Chaetura vauxi
Calliope Hummingbird	Stellula calliope
Rufous Hummingbird	Selasphorus rufus
Belted Kingfisher	Ceryle alcyon
Yellow-bellied Sapsucker	Sphyrapicus varius
Downy Woodpecker	Picoides pubescens
Hairy Woodpecker	Picoides villosus
Northern Flicker	Colaptes auratus
Pileated Woodpecker	Dryocopus pileatus
Western Wood-Pewee	Contopus sordidulus
Alder Flycatcher	Empidonax alnorum
Hammond's Flycatcher	Empidonax hammondii
Western Flycatcher	Empidonax difficilis
Northern Rough-winged Swallow	Stelgidopteryx serripennis
Barn Swallow	Riparia riparia
American Crow	Corvus brachyrhynchos
Black-capped Chickadee	Parus atricapillus
Mountain Chickadee	Parus gambeli
American Dipper	Cinclus mexicanus

(Appendix 1 continued)

Veery	Catharus fuscescens
Swainson's Thrush	Catharus ustulatus
American Robin	Turdus migratorius
Cedar Waxwing	Bombycilla cedrorum
Solitary Vireo	Vireo solitarius
Warbling Vireo	Vireo gilvus
Red-eyed Vireo	Vireo olivaceus
Nashville Warbler	Vermivora ruficapilla
Yellow Warbler	Dendroica petechia
Chestnut-sided Warbler	Dendroica pensylvanica
Yellow-rumped Warbler	Dendroica coronata
Townsend's Warbler	Dendroica townsendi
American Redstart	Setophaga ruticilla
Northern Waterthrush	Seiurus noveboracensis
MacGillivray's Warbler	Oporornis tolmiei
Wilson's Warbler	Wilsonia pusilla
Western Tanager	Piranga ludoviciana
Lazuli Bunting	Passerina amoena
Chipping Sparrow	Spizella passerina
Song Sparrow	Melospiza melodia
White-crowned Sparrow	Zonotrichia leucophrys
Brown-headed Cowbird	Molothrus ater
White-winged Crossbill	Loxia leucoptera
Pine Siskin	Carduelis pinus
American Goldfinch	Carduelis tristis